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1 [Level set and PDE methods for computer graphics](#)



David Breen, Ron Fedkiw, Ken Museth, Stanley Osher, Guillermo Sapiro, Ross Whitaker

 August 2004 **Proceedings of the conference on SIGGRAPH 2004 course notes GRAPH '04**

Publisher: ACM Press

 Full text available: [pdf\(17.07 MB\)](#) Additional Information: [full citation](#), [abstract](#)

Level set methods, an important class of partial differential equation (PDE) methods, define dynamic surfaces implicitly as the level set (iso-surface) of a sampled, evolving nD function. The course begins with preparatory material that introduces the concept of using partial differential equations to solve problems in computer graphics, geometric modeling and computer vision. This will include the structure and behavior of several different types of differential equations, e.g. the level set eq ...



2 [GPGPU: general purpose computation on graphics hardware](#)



David Luebke, Mark Harris, Jens Krüger, Tim Purcell, Naga Govindaraju, Ian Buck, Cliff Woolley, Aaron Lefohn

 August 2004 **Proceedings of the conference on SIGGRAPH 2004 course notes GRAPH '04**

Publisher: ACM Press

 Full text available: [pdf\(63.03 MB\)](#) Additional Information: [full citation](#), [abstract](#)

The graphics processor (GPU) on today's commodity video cards has evolved into an extremely powerful and flexible processor. The latest graphics architectures provide tremendous memory bandwidth and computational horsepower, with fully programmable vertex and pixel processing units that support vector operations up to full IEEE floating point precision. High level languages have emerged for graphics hardware, making this computational power accessible. Architecturally, GPUs are highly parallel s ...



3 [Real-time shading](#)



Marc Olano, Kurt Akeley, John C. Hart, Wolfgang Heidrich, Michael McCool, Jason L. Mitchell, Randi Rost

 August 2004 **Proceedings of the conference on SIGGRAPH 2004 course notes GRAPH '04**

Publisher: ACM Press

 Full text available: [pdf\(7.39 MB\)](#) Additional Information: [full citation](#), [abstract](#)


Real-time procedural shading was once seen as a distant dream. When the first version of

this course was offered four years ago, real-time shading was possible, but only with one-of-a-kind hardware or by combining the effects of tens to hundreds of rendering passes. Today, almost every new computer comes with graphics hardware capable of interactively executing shaders of thousands to tens of thousands of instructions. This course has been redesigned to address today's real-time shading capabili ...

4 Collision detection and proximity queries

 Sunil Hadap, Dave Eberle, Pascal Volino, Ming C. Lin, Stephane Redon, Christer Ericson
August 2004 **Proceedings of the conference on SIGGRAPH 2004 course notes GRAPH '04**

Publisher: ACM Press

Full text available:  [pdf\(11.22 MB\)](#) Additional Information: [full citation](#), [abstract](#)

This course will primarily cover widely accepted and proved methodologies in collision detection. In addition more advanced or recent topics such as continuous collision detection, ADFs, and using graphics hardware will be introduced. When appropriate the methods discussed will be tied to familiar applications such as rigid body and cloth simulation, and will be compared. The course is a good overview for those developing applications in physically based modeling, VR, haptics, and robotics.

5 The elements of nature: interactive and realistic techniques


 Oliver Deussen, David S. Ebert, Ron Fedkiw, F. Kenton Musgrave, Przemyslaw Prusinkiewicz, Doug Roble, Jos Stam, Jerry Tessendorf
August 2004 **Proceedings of the conference on SIGGRAPH 2004 course notes GRAPH '04**

Publisher: ACM Press

Full text available:  [pdf\(17.65 MB\)](#) Additional Information: [full citation](#), [abstract](#)

This updated course on simulating natural phenomena will cover the latest research and production techniques for simulating most of the elements of nature. The presenters will provide movie production, interactive simulation, and research perspectives on the difficult task of photorealistic modeling, rendering, and animation of natural phenomena. The course offers a nice balance of the latest interactive graphics hardware-based simulation techniques and the latest physics-based simulation techni ...

6 Three-dimensional medical imaging: algorithms and computer systems

 M. R. Stytz, G. Frieder, O. Frieder
December 1991 **ACM Computing Surveys (CSUR)**, Volume 23 Issue 4

Publisher: ACM Press

Full text available:  [pdf\(7.38 MB\)](#) Additional Information: [full citation](#), [references](#), [citations](#), [index terms](#), [review](#)

Keywords: Computer graphics, medical imaging, surface rendering, three-dimensional imaging, volume rendering

7 Multiprocessor experiments for high-speed ray tracing

 Severin Gaudet, Richard Hobson, Pradeep Chilka, Thomas Calvert
July 1988 **ACM Transactions on Graphics (TOG)**, Volume 7 Issue 3

Publisher: ACM Press

Full text available:  [pdf\(2.82 MB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

New single- and multiprocessor models for ray tracing are presented. Important features are (1) the use of custom VLSI building blocks, (2) the use of a modified hierarchical

data-structure-based ray tracing algorithm with three disjoint data sets, and (3) scene access through adaptive information broadcasting. A modular design is presented that permits incremental performance enhancement up to two orders of magnitude over conventional minicomputers or workstations. Ray tracing is a surpris ...

8 Dissertation Abstracts in Computer Graphics



January 1992 **ACM SIGGRAPH Computer Graphics**, Volume 26 Issue 1

Publisher: ACM Press

Full text available: pdf(2.53 MB) Additional Information: [full citation](#)



9 Tracing ray differentials



Homan Igehy

July 1999 **Proceedings of the 26th annual conference on Computer graphics and interactive techniques**

Publisher: ACM Press/Addison-Wesley Publishing Co.

Full text available: pdf(1.05 MB) Additional Information: [full citation](#), [references](#), [citing terms](#), [index terms](#)



10 Adaptive radiosity textures for bidirectional ray tracing



Paul S. Heckbert

September 1990 **ACM SIGGRAPH Computer Graphics , Proceedings of the 17th annual conference on Computer graphics and interactive techniques SIGGRAPH '90**, Volume 24 Issue 4

Publisher: ACM Press

Full text available: pdf(2.90 MB) Additional Information: [full citation](#), [abstract](#), [references](#), [citing terms](#), [index terms](#)

We present a rendering method designed to provide accurate, general simulation of global illumination for realistic image synthesis. Separating surface interaction into diffuse plus specular, we compute the specular component on the fly, as in ray tracing, and store the diffuse component (the radiosity) for later-reuse, similar to a radiosity algorithm. Radiosities are stored in *adaptive radiosity textures (rexes)*¹ that record the pattern of light and shadow on every diffuse su ...



11 Ray tracing: Multi-level ray tracing algorithm



Alexander Reshetov, Alexei Soupikov, Jim Hurley

July 2005 **ACM Transactions on Graphics (TOG)**, Volume 24 Issue 3

Publisher: ACM Press

Full text available: pdf(662.90 KB) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

We propose new approaches to ray tracing that greatly reduce the required number of operations while strictly preserving the geometrical correctness of the solution. A hierarchical "beam" structure serves as a proxy for a collection of rays. It is tested against a kd-tree representing the overall scene in order to discard from consideration the sub-set of the kd-tree (and hence the scene) that is guaranteed not to intersect with any possible ray inside the beam. This allows for all the rays insi ...

Keywords: anti-aliasing, frustum occlusion culling, ray-tracing



12 Real-time volume graphics



Klaus Engel, Markus Hadwiger, Joe M. Kniss, Aaron E. Lefohn, Christof Rezk Salama, Daniel Weiskopf



August 2004 Proceedings of the conference on SIGGRAPH 2004 course notes GRAPH '04**Publisher:** ACM PressFull text available:  pdf(7.63 MB) Additional Information: [full citation](#), [abstract](#)

The tremendous evolution of programmable graphics hardware has made high-quality real-time volume graphics a reality. In addition to the traditional application of rendering volume data in scientific visualization, the interest in applying these techniques for real-time rendering of atmospheric phenomena and participating media such as fire, smoke, and clouds is growing rapidly. This course covers both applications in scientific visualization, e.g., medical volume data, and real-time rendering, ...

13 Ray tracing on programmable graphics hardware

Timothy J. Purcell, Ian Buck, William R. Mark, Pat Hanrahan

July 2002 **ACM Transactions on Graphics (TOG) , Proceedings of the 29th annual conference on Computer graphics and interactive techniques SIGGRAPH '02**, Volume 21 Issue 3**Publisher:** ACM PressFull text available:  pdf(454.93 KB) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

Recently a breakthrough has occurred in graphics hardware: fixed function pipelines have been replaced with programmable vertex and fragment processors. In the near future, the graphics pipeline is likely to evolve into a general programmable stream processor capable of more than simply feed-forward triangle rendering. In this paper, we evaluate these trends in programmability of the graphics pipeline and explain how ray tracing can be mapped to graphics hardware. Using our simulator, we analyze ...

Keywords: programmable graphics hardware, ray tracing**14 A practical guide to global illumination using ray tracing and photon mapping**

Henrik Wann Jensen

August 2004 **Proceedings of the conference on SIGGRAPH 2004 course notes GRAPH '04****Publisher:** ACM PressFull text available:  pdf(697.07 KB) Additional Information: [full citation](#), [abstract](#)

This course serves as a practical guide to ray tracing and photon mapping. The notes are mostly aimed at readers familiar with ray tracing, who would like to add an efficient implementation of photon mapping to an existing ray tracer. The course itself also includes a description of the ray tracing algorithm. There are many reasons to augment a ray tracer with photon maps. Photon maps makes it possible to efficiently compute global illumination including caustics, diffuse color bleeding, and part ...

15 The holodeck ray cache: an interactive rendering system for global illumination in nondiffuse environments

Gregory Ward, Maryann Simmons

October 1999 **ACM Transactions on Graphics (TOG)**, Volume 18 Issue 4**Publisher:** ACM PressFull text available:  pdf(935.74 KB) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

We present a new method for rendering complex environments using interactive, progressive, view-independent, parallel ray tracing. A four-dimensional holodeck data structure serves as a rendering target and caching mechanism for interactive walkthroughs of nondiffuse environments with full global illumination. Ray sample density varies locally according to need, and on-demand ray computation is supported in a

parallel implementation. The holodeck file is stored on disk and ...

Keywords: illumination, image reconstruction, mesh generation, ray tracing, rendering system, virtual reality

16 Point-based computer graphics



Marc Alexa, Markus Gross, Mark Pauly, Hanspeter Pfister, Marc Stamminger, Matthias Zwicker

August 2004 **Proceedings of the conference on SIGGRAPH 2004 course notes GRAPH '04**

Publisher: ACM Press

Full text available: [pdf\(8.94 MB\)](#) Additional Information: [full citation](#), [abstract](#), [citations](#)

This course introduces points as a powerful and versatile graphics primitive. Speakers present their latest concepts for the acquisition, representation, modeling, processing, and rendering of point sampled geometry along with applications and research directions. We describe algorithms and discuss current problems and limitations, covering important aspects of point based graphics.

17 Architectures: Realtime ray tracing of dynamic scenes on an FPGA chip



Jörg Schmittler, Sven Woop, Daniel Wagner, Wolfgang J. Paul, Philipp Slusallek

August 2004 **Proceedings of the ACM SIGGRAPH/EUROGRAPHICS conference on Graphics hardware**

Publisher: ACM Press

Full text available: [pdf\(1.72 MB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [index terms](#)

Realtime ray tracing has recently established itself as a possible alternative to the current rasterization approach for interactive 3D graphics. However, the performance of existing software implementations is still severely limited by today's CPUs, requiring many CPUs for achieving realtime performance. In this paper we present a prototype implementation of the full ray tracing pipeline on a single FPGA chip. Running at only 90 MHz it achieves realtime frame rates of 20 to 60 frames per second ...

18 Real-time shadowing techniques



Tomas Akenine-Moeller, Eric Chan, Wolfgang Heidrich, Jan Kautz, Mark Kilgard, Marc Stamminger

August 2004 **Proceedings of the conference on SIGGRAPH 2004 course notes GRAPH '04**

Publisher: ACM Press

Full text available: [pdf\(11.17 MB\)](#) Additional Information: [full citation](#), [abstract](#)

Shadows heighten realism and provide important visual cues about the spatial relationships between objects. But integration of robust shadow shadowing techniques in real-time rendering is not an easy task. In this course on how shadows are incorporated in real-time rendering, attendees learn basic shadowing techniques and more advanced techniques that exploit new features of graphics hardware. The course begins with shadowing techniques using shadow maps. After an introduction to shadow maps and ...

19 Ray tracing vs. scan conversion: SaarCOR: a hardware architecture for ray tracing

Jörg Schmittler, Ingo Wald, Philipp Slusallek

September 2002 **Proceedings of the ACM SIGGRAPH/EUROGRAPHICS conference on Graphics hardware**

Publisher: Eurographics Association

Full text available: [pdf\(5.23 MB\)](#) Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

The ray tracing algorithm is well-known for its ability to generate high-quality images and its flexibility to support advanced rendering and lighting effects. Interactive ray tracing has been shown to work well on clusters of PCs and supercomputers but direct hardware support for ray tracing has been difficult to implement. In this paper, we present a new, scalable, modular, and highly efficient hardware architecture for real-time ray tracing. It achieves high performance with extremely low memory ...

20 Fast ray tracing by ray classification



James Arvo, David Kirk

August 1987 **ACM SIGGRAPH Computer Graphics , Proceedings of the 14th annual conference on Computer graphics and interactive techniques SIGGRAPH '87**, Volume 21 Issue 4

Publisher: ACM Press

Full text available: pdf (1.20 MB)

Additional Information: [full citation](#), [abstract](#), [references](#), [citations](#), [index terms](#)

We describe a new approach to ray tracing which drastically reduces the number of ray-object and ray-bounds intersection calculations by means of 5-dimensional space subdivision. Collections of rays originating from a common 3D rectangular volume and directed through a 2D solid angle are represented as hypercubes in 5-space. A 5D volume bounding the space of rays is dynamically subdivided into hypercubes, each linked to a set of objects which are candidates for intersection. Rays are classified ...

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